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STUDIES ON DIFFERENT TYPE OF SUTURES USING ALOE VERA GEL COATING

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ABSTRACT

Natural finishes like Alo vera, Neem, Turmeric etc have unique biomedical applications. The objective of this study is to give Aloe vera gel coating to textile yarns for suture application. Sutures are the most commonly used means of wound closure since ancient times. The textile yarns of all types like monofilament, multifilament, braided or staple yarns are used as non-absorbent suture based on type of wound closure required. Generally such sutures are coated with different type of antimicrobial finishes or sterilized. The Aloe vera coating on suture material would expedite the healing; hence tissue reaction can be controlled by standardizing such process. In this paper the Braided Polyester Suture is taken to standardize the process. At a later stage the work will be done to compare coating efficiency and performance offered by different samples of PP, PET, Nylon, Viscose and Bamboo Yarns and cost comparison with different suture yarns available in market.

KEYWORDS: Sutures, Non-Absorbable Microbiological, Braided, Bactericidal, Antimicrobial

INTRODUCTION

Suture is a Bio-Medical device, which is used to join the blood vessels and implants and thus bringing together the tissues for the process of healing in a trauma or surgery; and they need to stay there for a certain period until the ligature attains a certain amount of strength. Although THERE are other mechanical wound closure devices available like staples, adhesives and tapes but still sutures are the most preferred ones. Suture market has grown tremendously in last decade and has reached $1.3 billion annually. Owing to the critical nature of the suture function, it is often said that the life of a patient hangs by a tiny thread [(1)].

Suture materials are characterized by various methods involving mechanical and physical properties, handling characteristics, and biological and biodegradation behavior. Suture size is very important and it should be mentioned in any case. Similarly, whether the material is mono- or multi-filament or braided, etc. needs to be mentioned. Mechanical properties such as tensile strength, percentage elongation, modulus of elasticity, stress relaxation, and creep are measured routinely. The strength property is the most frequently reported mechanical characteristics of suture materials. There must be a proper match between the suture strength and the tissue strength. Strength includes knotted and unknotted (straight pull) tensile strengths. As capillarity is related to the ability to transport bacteria, it also needs to be measured. Other parameters measured are swelling and coefficient of friction. Pliability, packaging memory, knot security, knot tie-down, knot slippage, tissue drag, etc., are used to understand handling characteristics that are related to the ‘‘feel’’ of suture materials by surgeons during wound closure [(2), (3), (4)].

MEDICINAL VALUES OF ALOE VERA

Aloe Vera For over five thousand years, folk medicine has celebrated the juice of the aloe vera plant for its unique healing properties. Only recently, however, has modern medicine begun to unlock the deeper secrets of aloe and to place

the "miracle plant" under laboratory scrutiny. Aloe Vera belonging to the family Liliaceae is known as ‘Lily of the desert’. Aloe vera has been used as a skincare product for more than 2000 years. In modern times, scientific research has shown that the Aloe vera leaf contains over 75 nutrients and 200 active compounds, including 20 minerals, 18 amino acids and 12 vitamins. These rich constituent give the Aloe vera gel special property of early healing and less scaring along with anti microbial property. The aloe plant is a succulent, consisting of thick green leaves with a gelatinous substance inside. Aloe juice, properly processed, contains a wide variety of healing constituents. The principal attributes are: antiseptic, anti-inflammatory, and anti-viral. The plant produces six antiseptic agents: Lupeol, a natural salicylic acid, urea nitrogen, cinnamic acid, phenol, and sulfur all demonstrate anti-microbial effects. Lupeol and salicylic acid also have analgesic effects. Aloe contains three plant sterols, which are important fatty acids-HDL cholesterol (which lowers fats in the blood), campesterol, and B-sitosterol. All are helpful in reducing symptoms of allergies and acid indigestion. These compounds also aid in arthritis, rheumatic fever, both internal and external ulcers, and inflammation of the digestive system. The stomach, small intestine, liver, kidneys, and pancreas can all benefit from these anti inflammatory effects.

Recent research has suggested some exciting new possibilities. Aloe not only provides vigorous overall immune system support, but aids directly in the destruction of intravascular bacteria..Surgical products must therefore be improved continuously to keep pace with the strides being made by surgeons. Thus the search is unending to develop innovative wound closure products that promote wound healing, and help both the surgeon and mankind [(9)].

IMPORTANCE OF COATING ON SUTURES

The coated sutures gives lesser drag as the surface has been engineered accordingly and made smooth thus less traumatic while closing a wound. Antimicrobial treatment on Sutures is necessary to avoid cross infection by pathogenic micro organisms, to control the infestation by microbes, stop metabolism in microbes in order to reduce infection and prevent textile products from quality deterioration. It is important to take into account the impact of stress strain, thermal and mechanical effects on the sutures. The following requirements need to be satisfied to obtain maximum benefits like durability to washing, selective activity to undesirable micro organisms, No harmful effects to the manufacturer, user and the environment, compatibility with the chemical processes, easy method of application and resistant to body fluids; and resistant to disinfections/sterilisation. The antimicrobial agents can be applied to the textile substrates by exhaust, pad-dry-cure, coating, spray and foam techniques. The substances can also be applied by directly adding into the fibre spinning dope. It is claimed that the commercial agents can be applied online during processing. Various methods for improving the durability of the finish include [(11)]

- Insolubilisation of the active substances in/on the fibre.
- Treating the fibre with resin, condensates or cross-linking agents.
- Micro encapsulation of the antimicrobial agents with the fibre matrix.
- Coating the fibre surface.
- Chemical modification of the fibre by covalent bond formation.
- Use of graft polymers, homo polymers and/or co-polymerisation on to the fibre.

METHODOLOGY

The present work is carried out using braided polyester yarn (A), multifilament bamboo yarn (B),PET monofilament (C), PP-monofilament (D), PA-monofilament (E), viscose staple yarn (F), polyester staple yarn (G), steel

yarn (H) for standardizing the process of coating. The coating is done using Silver nano-particles synthesized using herbal extracts. Thus the process is eco-friendly as it has no harmful by-product. Several microbiological studies were carried out according to AATCC (USA, U. S. Pharmacopeia Norms). The present paper explains the process carried out on braided polyester yarns (A).

Silver nitrate was transformed into nano silver partical (NS) by reducing it with fructose in aqueous solution. Thirty milligrams silver nitrate was dissolved in 100mL deionized water under constant stirring at 30^0C. Subsequently, 5 ml of Aloe vera plant extract was added and stirring was continued for 30 min at 30^0C. Immobilization of NS on yarn was carried out by dipping the samples in the NS solution for 30 min at 4^0C. The flow diagram of the process for synthesizing and coating of silver nano particles on sutures is shown in Figure 1. The colour change indicates the synthesis of silver nano-particles.

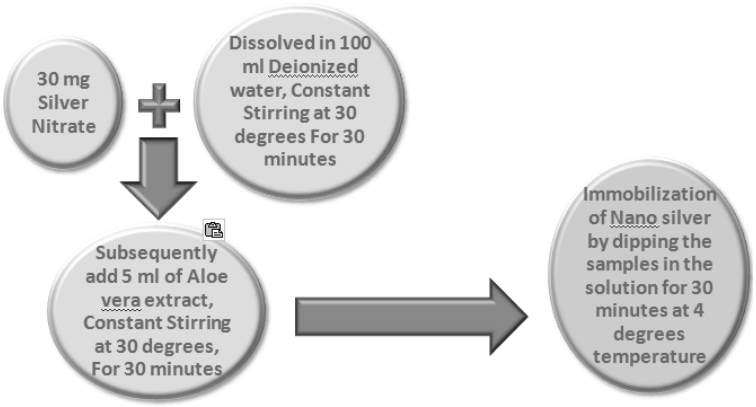


Figure 1: Synthesis of Silver Nano Particles Using Aloe Vera Coating

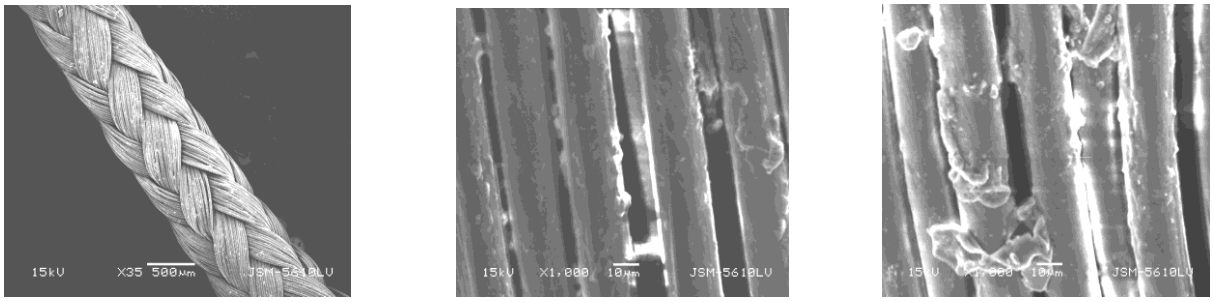
RESULTS AND DISCUSSIONS

The performance evaluation of different suture has been done by performing physical and microbiological testing. The behavior of suture materials has been studies by measuring different properties like tensile strength, elongation, Knot test, Bacterial colonization etc. Table 1 shows the performance of each variety of suture material. The sample A, F and G found superior during performance analysis for which the basic textile yarn structures and materials are responsible. Braided structure found most suitable for suture application. Antibacterial nature of samples was examined by zone of inhibition and viable cell count method, according to Test Method AATCC 100-1998. The antibacterial activity was checked against both Gram positive bacteria S. aureus (ATCC 25923) and Gram negative bacteria E. coli (ATCC 35218). Zone of Inhibition overnight cultures were suspended in Nutrient Broth of this suspension, 200mL was spread on Muller Hinton Agar (MHA) plates to obtain a semi-confluent growth. The sutures were then placed on the inoculated medium and the plates were kept for incubation for 24 h at 37^0C. The inhibition zones were then observed. The Photographs related to the studies shown in Figure 2. The braided yarn was coated by dip and freeze dry method.

Table 1: Performance of Varieties Sample

	A	B	C	D	E	F	G	H
Tensile Strength	+++++	+	+++	+++	+++	+++	+++	+++++
Elongation	+++	++	+	+	+	++	++	+
Rigidity	+	+	++++	++++	+++++	+	++	+++++
Knot Tensile Strength	+++++	++	+++	+++	+++	++++	++++	+++
Knot Security	+++++	+++	++	++	++	+++	+++	+
Bacterial Colonization	+++	++++	+	+	+	++++	+++++	+
Capillarity	+++	++	+	+	+	++++	+++++	+

+Poor, ++ Fair, +++ Good, ++++ Better, +++++ Best



a) Coated Yarn with Silver Nano Particles from Herbal Extracts

b) Coated Yarn Inhibition against Growth of Bacterial Colonies

c) Growth of Bacterial Colonies on Non-Coated Yarn

Figure 2: Bacterial Growth on Coated and Non-Coated Suture

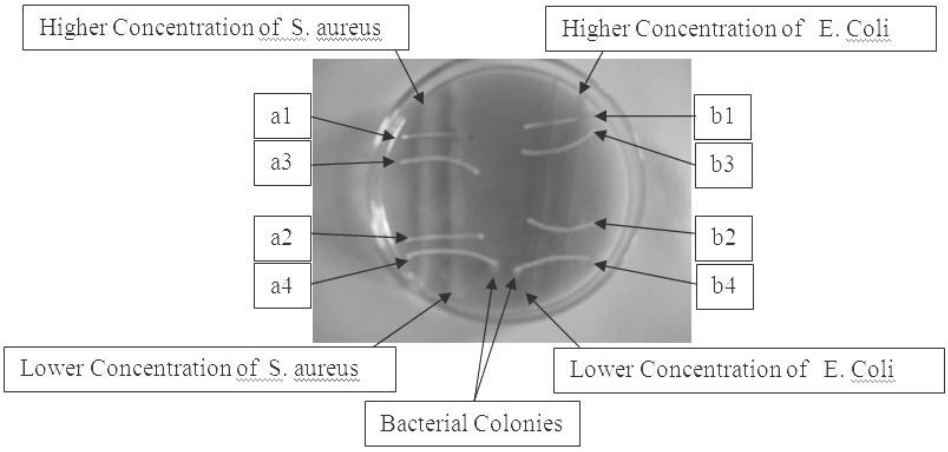


Figure 3: Microbiological Method for Evaluating Performance of Coated Suture

Samples are noted as a1, a2, b1, b2 with coated NS and a3, a4, b3, b4 without coating. Bacterial cultural study is showing bacterial growth on the non-coated samples prominent at the edges, while absent in case of coated yarn as shown in Figure 3. The sterile conditions need to be maintained for all apparatus and autoclaving is done after plugging all the apparatus with cotton plugs and wrapping in paper and tied properly and the suture yarns that are to be coated are sterilized for 2 hours in Ultra Violet Light for two hours. The contamination is observed if sterility is not maintained while handling the samples.

In this study braided yarn were developed and characterized. These new macromolecules materials could have two main beneficial features 1) Less microbial Growth, 2) Less Scar Formation. Such coated sutures could be used in emergency surgery or infected surgery. Further experiments by using an infectious animal model should be performed to adjust the dose/ effects of these materials in septic conditions on freshly operated patients. Moreover Using nano-silver particles could decrease the cytotoxicity effect and improve in vivo tissue response while preserving its antimicrobial characteristic. This kind of value adding finishes are the need of the hour, which should be very much cost effective so that the application is possible in real world

CONCLUSIONS

The braided yarn give better performance strength wise to hold the trauma or surgery, instead monofilament yarns can be used where less strength is required. Multi filament yarns are less recommended as it provides more room for anchorage of the bacteria and provide good condition for the body fluids to deposit as it has more capillarity. Steel yarn is recommended and is considered to be the best alternative for all kind of surgeries but it is very rigid and so gives very poor knot security while the braided yarn gives the best results.

REFERENCES

1. Chennakkattu Krishna et al.(2010), "Absorbable Polymeric Surgical Sutures: Chemistry, Production, Properties, Biodegradability, and Performance", Journal of Biomaterials Applications, Vol. 25, pg. 291.
2. Jin-Cheol Kim et al.(2007), "Comparison of tensile and knot security properties of surgical Sutures", J Mater Sci: Mater Med, Vol. 18(12), pg. 23-63.
3. Jean-Claude Harnet et al.(2009), "Anti-bacterial protection of suture material by chlorhexidinefunctionalized polyelec- trolyte multilayer films, Materials in Medicine, Vol. 20(1), pg. 185-193.
4. E. Karaca Bayraktar et al.(2001), "Investigating the Knot Performance of Silk, Polyamide, Polyester, Sutures", Textile Research Journal, Vol. 71(5), pg. 435-440.
5. Seungsin Lee et al.(1999), "Antimicrobial and Blood Repellent Finishes for Cotton and Nonwoven Fabrics Based on Chitosan and Fluoropolymers", Textile Research Journal, Vol. 69(2), pg. 104-112.
6. E. A. Kovtun et al.(2000), "Creation of Sutures With Antimicrobial Properties, Fiber Chemistry", Fiber Chemistry, Vol. 32(4), pg. 287-292.
7. Richard J. Huggins et al.(2007), "Histological and Ultrastructural Evaluation of Sutures Used for Surgical Fixation of the SMAS", Aesthetic Plast Surgery, Vol. 31(6), pg. 719, 2007.
8. Richard F. Edlich et al.(1973), "Physical and Chemical Configuration of Sutures in the Development of Surgical Infection", Annals of Surgery, Vol. 117(6), pg. 678-689.
9. Shalini Saxena et al.(2010), "Development of a New Polypropylene-Based Suture: Plasma Grafting, Surface Treatment, Characterization, and Biocompatibility Studies", Macromol. Biosci., Vol. 11(3), pg. 373.
10. Sharrif Moghaddasi M., et al.(2001), "Aloe vera their chemicals composition and applications", International Journal of Biological & Medical Research, Vol. 2(1), pg. 466-471.
11. L Shanmugasundaram (2007), "Antimicrobial finish in textiles", Processing, Dyeing & Finishing, The Indian Textile Journal.